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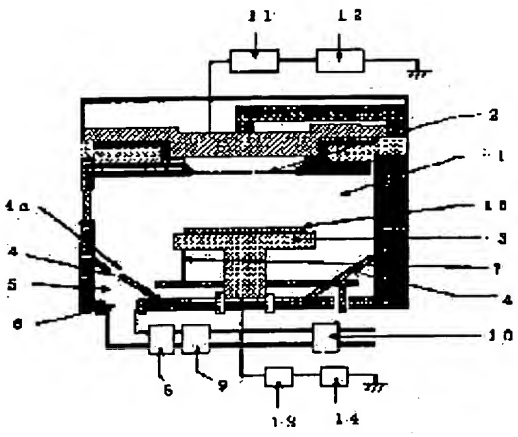
(54) PLASMA PROCESSING DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide superior film formation or etching characteristics by setting the cross sectional shape of an exhaust path, which is provided in a vacuum chamber connected to an exhaust port, to an approximately triangle shape, by preventing abnormal discharge such as a local discharge of a plasma processing device before happening, and by stably discharging.
SOLUTION: A plasma CVD device is provided with a vacuum chamber 1, a shower electrode 2 also served as a gas leading port, a bottom electrode 3 also served as a heater, a gas exhaust port 6, and a wafer transfer mechanism 7. The vacuum exhaust path 5 is formed into an approximately triangle cross section with an exhaust baffle 4, a side wall and a bottom of the vacuum chamber 1 set to respective sides. This constitution can expand the distance to the bottom electrode 3, and the acute angle part is not positioned near the bottom electrode so as to prevent abnormal discharge such as a local discharge, thereby providing the stable discharge A simple method for inserting the vacuum exhaust baffle 4 can constitute such a vacuum exhaust path as holding a long relative distance to the bottom electrode 3 and suppress the abnormal discharge.



CLAIMS

[Claim(s)]
[Claim 1] plasma treatment equipment characterize by the cross section configuration of the exhaust air path established in the vacuum chamber which lead to said exhaust port in the vacuum chamber in which vacua maintenance be possible in the plasma treatment equipment which have the RF electrode of the parallel plate mold for generate a plasma , a process gas diffuser , and flueing opening that lead to an evacuation facility be an outline triangle configuration .
[Claim 2] Plasma treatment equipment according to claim 1 characterized by having made the exhaust air baffle which is an outline reverse Ha configuration meet said vacuum chamber wall, and making the cross-section configuration of said exhaust air path into an outline triangle configuration.
[Claim 3] Said exhaust air baffle is plasma treatment equipment according to claim 2 characterized by coming to have a slit-like evacuation hole covering the whole periphery of the real aforementioned chamber.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the evacuation path formed in that vacuum chamber at a detail further about plasma treatment equipment.
[0002]
[Description of the Prior Art] Various kinds of plasma treatment equipments, such as plasma-CVD equipment (it is described as P-CVD system below), a sputtering system, and an etching system, are used for manufacture of the thin film application device represented by IC, LSI, TFT liquid crystal, etc.
[0003] For example, plasma-CVD equipment is excellent in high-speed membrane formation, the low dental-curing film, step coverage nature, adhesion, etc., and is a promising thin film device manufacturing installation.
[0004] Drawing 4 is the outline sectional view showing an example of P-CVD system. In the vacuum chamber 1, the shower electrode 2 which serves as gas induction, and the lower electrode 3 which serves both as a wafer heating heater are countered and equipped. The evacuation system is constituted by the evacuation path 5 formed with the wall of the evacuation baffle 4 which restricts the evacuation path in the vacuum chamber 1, and the vacuum chamber 1, the flueing opening 6 prepared in vacuum chamber 1 lower part, the closing motion bulb 8 of the exhaust air path prepared in the exhaust-pipe-arrangement path, the exhaust air conductance modulating valve 9, and the evacuation pump 10 grade.
[0005] A wafer 15 is transferred on the lower electrode 3 held by the carrier robot (not shown) from the load lock chamber at 250-450 degrees C, and is adjusted to 5-50mm predetermined discharging gap length. Next, in the case of a silicon nitride (SiN film), a mono silane (SiH4), ammonia (NH3), and nitrogen (N2) gas are respectively introduced in one in a vacuum chamber through 10 - 500SCCM, 10 - 500SCCM and 100 - 7000SCCM, and the shower electrode 2. Then, with the conductance modulating valve 9 prepared in the evacuation system, through the RF adjustment machine 11, it is adjusted to the pressure of 0.1 - 8Torr, and the 13.56MHz high-

frequency power of 50-1000W is supplied to the shower electrode 2, between the shower electrode 2 and the lower electrode 3, the plasma is generated and film formation is performed from RF generator 12.
[0006] In addition, in the case of silicon oxide, introductory gas serves as same process only by changing to SiH4, N2O, etc.
[0007] In the above, the process gas introduced from the shower electrode 2 passes along 4-12 hole 4a which was shown by the arrow head A in drawing 4 and which was able to be mostly opened in the evacuation baffle 4 at equal intervals like, and the evacuation path 5, and is led from the exhaust port 6 to the evacuation pump 10. Thus, by forming the evacuation baffle 4, the process gas introduced into the vacuum chamber 1 from the shower electrode 2 came to go to an exhaust port isotropic, and the distribution in the 15th page of a wafer is improved.
[0008]
[Problem(s) to be Solved by the Invention] However, on the film formed by such [usually] approach, residual membrane stress has arisen according to membrane formation process conditions. Such residual stress (it is henceforth described as stress briefly) became the curvature of a wafer, and had brought about failures, such as breakage on devices, such as a wafer crack, and a crack, film exfoliation, and location gap of a pattern. And these failures were becoming a still more important technical problem with diameter[of macrostomia]-izing of a wafer in recent years, and detailed-izing. Specifically, process conditions, an equipment device, etc. which control membrane stress to two or less 1E+08 - 1E+09 dyn/cm compressive stress have been searched for.
[0009] Such stress control was conventionally carried out by process parameters, such as charge RF power and discharge gas pressure, etc., and also the method of impressing 50-500kHz low frequency bias to the lower electrode 3 carrying a wafer 15 etc. is proposed. The stress control by low frequency bias impressed the 13.56MHz RF to the shower electrode 2 usually performed, and its one independently controllable parameter increased compared with the power and the approach of controlling by process parameters, such as gas pressure, and it was one of the promising technique. However, although it is the comparatively low frequency of 50-500kHz, if high-frequency power is conventionally impressed to the lower electrode 3 which was a chamber ground earth electrode, the problem said that local or overall discharge arises among the chamber ground touch-down potential components which constitute the evacuation path 5 containing the evacuation baffle 4 formed in about three lower electrode will have come to occur. The distance of the lower electrode 3 and the evacuation path 5 is the distance comparison with the shower electrode 2, this is relatively near, and since the cross section of an exhaust air path is an outline square configuration, it is considered to be generated, in order that the acute angle corner which is about 90 degrees may be near the lower electrode 3 and may tend to cause partial discharge.
[0010] For this reason, or it enlarges the vacuum chamber 1 and earns the evacuation path 5 and the distance of the lower electrode 3, formation of the evacuation path 5 is canceled and the approach of carrying out direct evacuation from the flueing opening 6, the approach of forming the structure of the evacuation path 5 with SERAMMIKUSU components, such as an alumina, etc. are taken. However, in enlargement of equipment, the equipment manufacturing cost increased and a new technical problem called buildup of a footprint (equipment installation area) had generated these countermeasures. Moreover, in order to cancel formation of the evacuation path 5 and to make flow of gas into homogeneity, two or more flueing

openings 6 needed to be formed, and the equipment configuration was complicated, and enlargement was caused depending on the case. Moreover, the structure was invited for buildup of an equipment manufacturing cost for forming the evacuation path 5 with the ingredient of ceramic systems, such as an alumina.
[0011] Moreover, although the usual reactant etching system was impressing 13.56MHz high-frequency power to the lower electrode which serves as a wafer maintenance base, partial discharge with the evacuation path 6 poses a problem more than the low frequency bias of the above-mentioned P-CVD system, and it was coping with it by the above-mentioned technique, and had the same technical problem.
[0012]
[Means for Solving the Problem] in order to solve an above-mentioned trouble , invention according to claim 1 be the plasma treatment equipment characterize by the cross section configuration of the exhaust air path established in the vacuum chamber which lead to said exhaust port in the vacuum chamber in which vacua maintenance be possible in the plasma treatment equipment which have the RF electrode of the parallel plate mold for generate a plasma , a process gas diffuser , and flueing opening that lead to an evacuation facility be an outline triangle configuration .
[0013] It is plasma treatment equipment according to claim 1 characterized by for invention according to claim 2 having made the exhaust air baffle which is an outline reverse Ha configuration meet said vacuum chamber wall, and making said cross-section configuration an outline triangle configuration.
[0014] It is plasma treatment equipment according to claim 2 with which invention according to claim 3 is characterized by said exhaust air baffle coming to have a slit-like evacuation hole covering the whole periphery of the real aforementioned chamber.
[0015]
[Embodiment of the Invention] Hereafter, the example of this invention is explained based on a drawing.
[0016] Drawing 1 is the outline sectional view of P-CVD system of the 1st example of this invention. As for the shower electrode with which 1 serves as a vacuum chamber and 2 serves as a gas inlet, the lower electrode with which 3 serves as a heater, and 6, in drawing 1 , flueing opening and 7 are wafer transfer devices (the so-called lift pin). The evacuation path 5 is formed in the configuration with the side attachment wall of the exhaust air baffle 4 and the vacuum chamber 1, and the cross section of the outline triangle configuration which makes a base one side respectively.
[0017] Moreover, the evacuation path 5 has led to the flueing opening 6, the closing motion bulb 8 of an exhaust air path, the exhaust air conductance modulating valve 9, and the evacuation pump 10 grade. With a diameter of 5-30mm hole 4a opens in a hoop direction at 4-16 regular intervals so that the gas stream in the vacuum chamber 1 may be made the exhaust air baffle 4 in consideration of exhaust air conductance at homogeneity, and it is ********. Moreover, it connects with the shower electrode 2 through the RF adjustment machine 11 at 13.56MHz RF generator 12. Moreover, it connects with the 50 - 500kHz adjustable low frequency power source 14 through the adjustment machine 13 for low frequency at the lower electrode 3, and has structure in which low frequency bias impression is possible. In addition, although not illustrated, the pass for RFs is prepared in the pass for low frequency, and the lower electrode 3 at the shower electrode 2.
[0018] One example of the exhaust air baffle 4 used for drawing 2 (A) at drawing 1 is shown. If the exhaust air baffle 4 of drawing 2 (A) inserts it in the wall of the vacuum chamber 1 with a ****** form as the cross-section configuration is carrying out the outline reverse Ha configuration and it is shown in drawing 1 , the cross-section

configuration can form the evacuation path 5 of an outline triangle. In the side attachment wall of the vacuum chamber 1, or the ends adjacent to a base, although the exhaust air baffle 4 shown in drawing 2 (A) has performed bending (4b, 4c) for installation stabilization, clearance control, etc., even if it is a straight line-like, it is convenient in any way.

[0019] By the simple technique of inserting the evacuation baffle 4 with such structure, the evacuation path which can take a long relative distance with the lower electrode 3 can be formed, and abnormality discharge of partial discharge etc. can be controlled.

[0020] In addition, since the exhaust air baffle 4 is formed in the configuration which suppresses partial discharge fundamentally, of course, ceramics, such as an alumina, has metallic materials usable [the baffle], such as Fe system alloys, such as aluminum, aluminum alloy, and SUS. Therefore, there is no need of using expensive components, such as ceramics, and handling also becomes easy. Moreover, since the above-mentioned metal exhaust air baffle 4 raises plasma resistance, it can also perform surface treatment, such as alumite processing, fluoride processing, ceramic thermal spraying, and plating, if needed. Moreover, although hole 4a opened in the exhaust air baffle 4 has made the hole of the same magnitude at equal intervals, it is also possible to change the magnitude of a hole from physical relationship with downward flueing opening, or to change spacing, and to carry out. The bore diameter and the number which are prepared in the exhaust air baffle 4 should just be a design which is not limited to the above-mentioned example and makes a gas stream homogeneity in consideration of exhaust air conductance.

[0021] The membrane formation process using P-CVD system shown in drawing 1 is explained. First, the Si wafer 15 is carried in to the vacuum chamber 1 by which evacuation was carried out, SiH4 (silane), NH3 (ammonia), and N2 (nitrogen) are respectively introduced as process gas for membrane formation through 10 - 500SCCM, 10 - 500SCCM, 100 - 7000SCCM, and the shower electrode 2, and the exhaust air conductance modulating valve 9 prepared in the gas pressure of 0.1 - 8Torr at the exhaust air system adjusts. Substrate temperature is set as 250-450 degrees C, and the discharging gap (the shower electrode 2 and distance between the lower electrodes 3) is set as 5-50mm. Then, from the RF electrical power system 12, while 13.56MHz high-frequency power supplies the shower electrode 2 100-1000W through the RF adjustment machine 11, 50-500kHz low frequency power is supplied to the lower electrode 3 50-1000W through the low frequency adjustment machine 13 from the low frequency power source 14. The discharge stabilized between the shower electrode 2 which counters, and the lower electrode 3 was able to be caused without fully detaching the lower electrode 3, the evacuation path 5, or the exhaust air baffle 4 in P-CVD system of this example, and causing partial discharge between them at this time. Moreover, the SiN film formation in which the process gas introduced into the vacuum chamber 1 from the shower electrode 2 by two or more exhaust air hole 4a prepared in the baffle 4 which forms the exhaust air path 5 flows the wafer 15 top to homogeneity, and has the outstanding thickness distribution of **3 - 5% or less of thickness distribution, and stress also has the compressive stress by which 1E+08 - 1E+09 dyn/cm2 was controlled small was attained.

[0022] In addition, in this example, although especially processing of the wall of the vacuum chamber 1 is not carried out, it can also establish the device for the installation stability of the exhaust air baffle 4 etc. Moreover, in order to enlarge area of the exhaust air path 5 and to make exhaust air conductance small, it is possible to put a delete lump into a part of wall section of the vacuum chamber 1 which forms the

exhaust air path 5 etc. Moreover, even if it is a cross-section configuration with a curve which used R processing for angle processing of the pars basilaris ossis occipitalis of the vacuum chamber 1 which constitutes the evacuation path 5, it does not interfere.

[0023] Drawing 2 (B) is the exhaust air baffle 4 of the 2nd example of this invention. The upper part of the exhaust air baffle 4 is equipped with evacuation hole 4e of the shape of a slit of 0.5-5mm width of face. On structure, although 4f of parts into which a 2-6-place slit goes out was made, it became possible to lead in an evacuation path isotropic, without gathering in the exhaust port 6 for which the gas stream was limited by formation of the exhaust air path 5 covering the whole periphery of such a vacuum chamber 1. Consequently, the thickness distribution shown in the 1st example is improved further, **0.5 - 2% or less of distribution is acquired, and the field of the periphery section of a wafer 15 which can be device manufactured was able to be made to expand.

[0024] Drawing 3 is an outline sectional view when a reactive ion etching system applies the plasma treatment equipment of this invention.

[0025] Although the basic configuration of equipment is the same as P-CVD system of drawing 1 , it is connected to the lower electrode 3 with which RF generator 12 serves as a wafer maintenance electrode. Using drawing 2 (A) or the exhaust air baffle 4 as shown in (B), the evacuation path 5 made distance with the lower electrode 3 large, and has controlled partial discharge etc.

[0026] It lets the shower electrode 2 pass for the gas containing oxygen, such as O2 and N2O, the gas of the fluorine system of CF4, C2F6, and NF3 grade, and if needed. It introduces in the vacuum chamber 1, and adjusts to the gas pressure of 0.01 - 1Torr, and the 13.56MHz high-frequency power 100-1000W is supplied to the lower electrode 3. The SiN film, Or the outstanding property of **3% or less of etch uniformity was acquired, without causing partial discharge, when SiO2 film etc. was etched.

[0027] In addition, although this example has explained the case where high-frequency power including low frequency is impressed to the lower electrode 3, an usable thing cannot be overemphasized even if the lower electrode 3 is equipment of chamber ground touch-down potential.

[0028] As mentioned above, in each example of this invention, although mainly explained based on the process about the SiN film, it is applicable also to membrane formation equipments, such as SiO2 and an amorphous silicon, and a reactant etching system. Moreover, in each example, although main discharge showed the example of 13.56MHz high frequency discharge, it can also apply the discharge by the low frequency from 50kHz, or discharge by microwave. With the insulator layer formation equipment using the high density plasma in recent years, the bias CVD approach is especially used for [for the embedding of a detailed pattern] flattening, and the exhaust air path and exhaust air baffle in connection with this invention are effective. Moreover, even if equipment is other objects for thin film devices, such as an object for semi-conductors, an object for liquid crystal or a thin film solar cell, and the thin film magnetic head, it is change of the magnitude of equipment etc., and a basic component does not change but can apply this invention.

[0029]

[Effect of the Invention] As above, with the plasma treatment equipment of this invention By making into an outline triangle configuration the cross section of the evacuation path in the vacuum chamber connected with flueing opening Distance with a lower electrode can be made large, and an acute angle angle like an outline square

configuration stops existing near the lower electrode, the discharge which controlled abnormality discharge of partial discharge etc. and was stabilized is obtained, and the outstanding membrane formation or the plasma treatment equipment which has an etching property is obtained. Moreover, without [without it enlarges a vacuum chamber by inserting the cross-section configuration in the plasma treatment equipment of claim 2 in the form where the exhaust air baffle which is an outline reverse Ha configuration is made to meet said vacuum chamber wall, and] establishing a complicated device, cheaply, a cross section can form the evacuation path of an outline triangle configuration, and plasma treatment equipment with the stable discharge property is obtained. Furthermore, with the plasma treatment equipment of claim 3, a gas stream can be drawn in an evacuation path isotropic, and the thickness distribution formed can be improved further.

TECHNICAL FIELD

[Field of the Invention] This invention relates to the evacuation path formed in that vacuum chamber at a detail further about plasma treatment equipment.

PRIOR ART

[Description of the Prior Art] Various kinds of plasma treatment equipments, such as plasma-CVD equipment (it is described as P-CVD system below), a sputtering system, and an etching system, are used for manufacture of the thin film application device represented by IC, LSI, TFT liquid crystal, etc.

[0003] For example, plasma-CVD equipment is excellent in high-speed membrane formation, the low dental-curing film, step coverage nature, adhesion, etc., and is a promising thin film device manufacturing installation.

[0004] Drawing 4 is the outline sectional view showing an example of P-CVD system. In the vacuum chamber 1, the shower electrode 2 which serves as gas induction, and the lower electrode 3 which serves both as a wafer heating heater are countered and equipped. The evacuation system is constituted by the evacuation path 5 formed with the wall of the evacuation baffle 4 which restricts the evacuation path in the vacuum chamber 1, and the vacuum chamber 1, the flueing opening 6 prepared in vacuum chamber 1 lower part, the closing motion bulb 8 of the exhaust air path prepared in the exhaust-pipe-arrangement path, the exhaust air conductance modulating valve 9, and the evacuation pump 10 grade.

[0005] A wafer 15 is transferred on the lower electrode 3 held by the carrier robot (not shown) from the load lock chamber at 250-450 degrees C, and is adjusted to 5-50mm predetermined discharging gap length. Next, in the case of a silicon nitride (SiN film), a mono silane (SiH4), ammonia (NH3), and nitrogen (N2) gas are respectively introduced in one in a vacuum chamber through 10 - 500SCCM, 10 - 500SCCM and 100 - 7000SCCM, and the shower electrode 2. Then, with the conductance modulating valve 9 prepared in the evacuation system, through the RF adjustment machine 11, it is adjusted to the pressure of 0.1 - 8Torr, and the 13.56MHz high-frequency power of 50-1000W is supplied to the shower electrode 2, between the shower electrode 2 and the lower electrode 3, the plasma is generated and film formation is performed from RF generator 12.

[0006] In addition, in the case of silicon oxide, introductory gas serves as same

process only by changing to SiH4, N2O, etc.
[0007] In the above, the process gas introduced from the shower electrode 2 passes along 4-12 hole 4a which was shown by the arrow head A in drawing 4 and which was able to be mostly opened in the evacuation baffle 4 at equal intervals like, and the evacuation path 5, and is led from the exhaust port 6 to the evacuation pump 10. Thus, by forming the evacuation baffle 4, the process gas introduced into the vacuum chamber 1 from the shower electrode 2 came to go to an exhaust port isotropic, and the distribution in the 15th page of a wafer is improved.

EFFECT OF THE INVENTION

[Effect of the Invention] As above, with the plasma treatment equipment of this invention By making into an outline triangle configuration the cross section of the evacuation path in the vacuum chamber connected with flueing opening Distance with a lower electrode can be made large, and an acute angle angle like an outline square configuration stops existing near the lower electrode, the discharge which controlled abnormality discharge of partial discharge etc. and was stabilized is obtained, and the outstanding membrane formation or the plasma treatment equipment which has an etching property is obtained. Moreover, without [without it enlarges a vacuum chamber by inserting the cross-section configuration in the plasma treatment equipment of claim 2 in the form where the exhaust air baffle which is an outline reverse Ha configuration is made to meet said vacuum chamber wall, and] establishing a complicated device, cheaply, a cross section can form the evacuation path of an outline triangle configuration, and plasma treatment equipment with the stable discharge property is obtained. Furthermore, with the plasma treatment equipment of claim 3, a gas stream can be drawn in an evacuation path isotropic, and the thickness distribution formed can be improved further.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, on the film formed by such [usually] approach, residual membrane stress has arisen according to membrane formation process conditions. Such residual stress (it is henceforth described as stress briefly) became the curvature of a wafer, and had brought about failures, such as breakage on devices, such as a wafer crack, and a crack, film exfoliation, and location gap of a pattern. And these failures were becoming a still more important technical problem with diameter[of macrostomia]-izing of a wafer in recent years, and detailed-izing. Specifically, process conditions, an equipment device, etc. which control membrane stress to two or less 1E+08 - 1E+09 dyn/cm compressive stress have been searched for.
[0009] Such stress control was conventionally carried out by process parameters, such as charge RF power and discharge gas pressure, etc., and also the method of impressing 50-500kHz low frequency bias to the lower electrode 3 carrying a wafer 15 etc. is proposed. The stress control by low frequency bias impressed the 13.56MHz RF to the shower electrode 2 usually performed, and its one independently controllable parameter increased compared with the power and the approach of controlling by process parameters, such as gas pressure, and it was one of the promising technique. However, although it is the comparatively low frequency of 50-

500kHz, if high-frequency power is conventionally impressed to the lower electrode 3 which was a chamber ground earth electrode, the problem said that local or overall discharge arises among the chamber ground touch-down potential components which constitute the evacuation path 5 containing the evacuation baffle 4 formed in about three lower electrode will have come to occur. The distance of the lower electrode 3 and the evacuation path 5 is the distance comparison with the shower electrode 2, this is relatively near, and since the cross section of an exhaust air path is an outline square configuration, it is considered to be generated, in order that the acute angle corner which is about 90 degrees may be near the lower electrode 3 and may tend to cause partial discharge.

[0010] For this reason, or it enlarges the vacuum chamber 1 and earns the evacuation path 5 and the distance of the lower electrode 3, formation of the evacuation path 5 is canceled and the approach of carrying out direct evacuation from the flueing opening 6, the approach of forming the structure of the evacuation path 5 with SERAMMIKUSU components, such as an alumina, etc. are taken. However, in enlargement of equipment, the equipment manufacturing cost increased and a new technical problem called buildup of a footprint (equipment installation area) had generated these countermeasures. Moreover, in order to cancel formation of the evacuation path 5 and to make flow of gas into homogeneity, two or more flueing openings 6 needed to be formed, and the equipment configuration was complicated, and enlargement was caused depending on the case. Moreover, the structure was invited for buildup of an equipment manufacturing cost for forming the evacuation path 5 with the ingredient of ceramic systems, such as an alumina.

[0011] Moreover, although the usual reactant etching system was impressing 13.56MHz high-frequency power to the lower electrode which serves as a wafer maintenance base, partial discharge with the evacuation path 6 poses a problem more than the low frequency bias of the above-mentioned P-CVD system, and it was coping with it by the above-mentioned technique, and had the same technical problem.

MEANS

[Means for Solving the Problem] in order to solve an above-mentioned trouble , invention according to claim 1 be the plasma treatment equipment characterize by the cross section configuration of the exhaust air path established in the vacuum chamber which lead to said exhaust port in the vacuum chamber in which vacua maintenance be possible in the plasma treatment equipment which have the RF electrode of the parallel plate mold for generate a plasma , a process gas diffuser , and flueing opening that lead to an evacuation facility be an outline triangle configuration .

[0013] It is plasma treatment equipment according to claim 1 characterized by for invention according to claim 2 having made the exhaust air baffle which is an outline reverse Ha configuration meet said vacuum chamber wall, and making said cross-section configuration an outline triangle configuration.

[0014] It is plasma treatment equipment according to claim 2 with which invention according to claim 3 is characterized by said exhaust air baffle coming to have a slit-like evacuation hole covering the whole periphery of the real aforementioned chamber.

[0015]

[Embodiment of the Invention] Hereafter, the example of this invention is explained based on a drawing.

[0016] Drawing 1 is the outline sectional view of P-CVD system of the 1st example

of this invention. As for the shower electrode with which 1 serves as a vacuum chamber and 2 serves as a gas inlet, the lower electrode with which 3 serves as a heater, and 6, in drawing 1 , flueing opening and 7 are wafer transfer devices (the so-called lift pin). The evacuation path 5 is formed in the configuration with the side attachment wall of the exhaust air baffle 4 and the vacuum chamber 1, and the cross section of the outline triangle configuration which makes a base one side respectively.
[0017] Moreover, the evacuation path 5 has led to the flueing opening 6, the closing motion bulb 8 of an exhaust air path, the exhaust air conductance modulating valve 9, and the evacuation pump 10 grade. With a diameter of 5-30mm hole 4a opens in a hoop direction at 4-16 regular intervals so that the gas stream in the vacuum chamber 1 may be made the exhaust air baffle 4 in consideration of exhaust air conductance at homogeneity, and it is ********. Moreover, it connects with the shower electrode 2 through the RF adjustment machine 11 at 13.56MHz RF generator 12. Moreover, it connects with the 50 - 500kHz adjustable low frequency power source 14 through the adjustment machine 13 for low frequency at the lower electrode 3, and has structure in which low frequency bias impression is possible. In addition, although not illustrated, the pass for RFs is prepared in the pass for low frequency, and the lower electrode 3 at the shower electrode 2.
[0018] One example of the exhaust air baffle 4 used for drawing 2 (A) at drawing 1 is shown. If the exhaust air baffle 4 of drawing 2 (A) inserts it in the wall of the vacuum chamber 1 with a ****** form as the cross-section configuration is carrying out the outline reverse Ha configuration and it is shown in drawing 1 , the cross-section configuration can form the evacuation path 5 of an outline triangle. In the side attachment wall of the vacuum chamber 1, or the ends adjacent to a base, although the exhaust air baffle 4 shown in drawing 2 (A) has performed bending (4b, 4c) for installation stabilization, clearance control, etc., even if it is a straight line-like, it is convenient in any way.
[0019] By the simple technique of inserting the evacuation baffle 4 with such structure, the evacuation path which can take a long relative distance with the lower electrode 3 can be formed, and abnormality discharge of partial discharge etc. can be controlled.
[0020] In addition, since the exhaust air baffle 4 is formed in the configuration which suppresses partial discharge fundamentally, of course, ceramics, such as an alumina, has metallic materials usable [the baffle], such as Fe system alloys, such as aluminum, aluminum alloy, and SUS. Therefore, there is no need of using expensive components, such as ceramics, and handling also becomes easy. Moreover, since the above-mentioned metal exhaust air baffle 4 raises plasma resistance, it can also perform surface treatment, such as alumite processing, fluoride processing, ceramic thermal spraying, and plating, if needed. Moreover, although hole 4a opened in the exhaust air baffle 4 has made the hole of the same magnitude at equal intervals, it is also possible to change the magnitude of a hole from physical relationship with downward flueing opening, or to change spacing, and to carry out. The bore diameter and the number which are prepared in the exhaust air baffle 4 should just be a design which is not limited to the above-mentioned example and makes a gas stream homogeneity in consideration of exhaust air conductance.
[0021] The membrane formation process using P-CVD system shown in drawing 1 is explained. First, the Si wafer 15 is carried in to the vacuum chamber 1 by which evacuation was carried out, SiH4 (silane), NH3 (ammonia), and N2 (nitrogen) are respectively introduced as process gas for membrane formation through 10 - 500SCCM, 10 - 500SCCM, 100 - 7000SCCM, and the shower electrode 2, and the

exhaust air conductance modulating valve 9 prepared in the gas pressure of 0.1 - 8Torr at the exhaust air system adjusts. Substrate temperature is set as 250-450 degrees C, and the discharging gap (the shower electrode 2 and distance between the lower electrodes 3) is set as 5-50mm. Then, from the RF electrical power system 12, while 13.56MHz high-frequency power supplies the shower electrode 2 100-1000W through the RF adjustment machine 11, 50-500kHz low frequency power is supplied to the lower electrode 3 50-1000W through the low frequency adjustment machine 13 from the low frequency power source 14. The discharge stabilized between the shower electrode 2 which counters, and the lower electrode 3 was able to be caused without fully detaching the lower electrode 3, the evacuation path 5, or the exhaust air baffle 4 in P-CVD system of this example, and causing partial discharge between them at this time. Moreover, the SiN film formation in which the process gas introduced into the vacuum chamber 1 from the shower electrode 2 by two or more exhaust air hole 4a prepared in the baffle 4 which forms the exhaust air path 5 flows the wafer 15 top to homogeneity, and has the outstanding thickness distribution of **3 - 5% or less of thickness distribution, and stress also has the compressive stress by which 1E+08 - 1E+09 dyn/cm2 was controlled small was attained.

[0022] In addition, in this example, although especially processing of the wall of the vacuum chamber 1 is not carried out, it can also establish the device for the installation stability of the exhaust air baffle 4 etc. Moreover, in order to enlarge area of the exhaust air path 5 and to make exhaust air conductance small, it is possible to put a delete lump into a part of wall section of the vacuum chamber 1 which forms the exhaust air path 5 etc. Moreover, even if it is a cross-section configuration with a curve which used R processing for angle processing of the pars basilaris ossis occipitalis of the vacuum chamber 1 which constitutes the evacuation path 5, it does not interfere.

[0023] Drawing 2 (B) is the exhaust air baffle 4 of the 2nd example of this invention. The upper part of the exhaust air baffle 4 is equipped with evacuation hole 4e of the shape of a slit of 0.5-5mm width of face. On structure, although 4f of parts into which a 2-6-place slit goes out was made, it became possible to lead in an evacuation path isotropic, without gathering in the exhaust port 6 for which the gas stream was limited by formation of the exhaust air path 5 covering the whole periphery of such a vacuum chamber 1. Consequently, the thickness distribution shown in the 1st example is improved further, **0.5 - 2% or less of distribution is acquired, and the field of the periphery section of a wafer 15 which can be device manufactured was able to be made to expand.

[0024] Drawing 3 is an outline sectional view when a reactive ion etching system applies the plasma treatment equipment of this invention.

[0025] Although the basic configuration of equipment is the same as P-CVD system of drawing 1 , it is connected to the lower electrode 3 with which RF generator 12 serves as a wafer maintenance electrode. Using drawing 2 (A) or the exhaust air baffle 4 as shown in (B), the evacuation path 5 made distance with the lower electrode 3 large, and has controlled partial discharge etc.

[0026] It lets the shower electrode 2 pass for the gas containing oxygen, such as O2 and N2O, the gas of the fluorine system of CF4, C2F6, and NF3 grade, and if needed. It introduces in the vacuum chamber 1, and adjusts to the gas pressure of 0.01 - 1Torr, and the 13.56MHz high-frequency power 100-1000W is supplied to the lower electrode 3. The SiN film, Or the outstanding property of **3% or less of etch uniformity was acquired, without causing partial discharge, when SiO2 film etc. was etched.

[0027] In addition, although this example has explained the case where high-frequency power including low frequency is impressed to the lower electrode 3, an usable thing cannot be overemphasized even if the lower electrode 3 is equipment of chamber ground touch-down potential.
[0028] As mentioned above, in each example of this invention, although mainly explained based on the process about the SiN film, it is applicable also to membrane formation equipments, such as SiO2 and an amorphous silicon, and a reactant etching system. Moreover, in each example, although main discharge showed the example of 13.56MHz high frequency discharge, it can also apply the discharge by the low frequency from 50kHz, or discharge by microwave. With the insulator layer formation equipment using the high density plasma in recent years, the bias CVD approach is especially used for [for the embedding of a detailed pattern] flattening, and the exhaust air path and exhaust air baffle in connection with this invention are effective. Moreover, even if equipment is other objects for thin film devices, such as an object for semi-conductors, an object for liquid crystal or a thin film solar cell, and the thin film magnetic head, it is change of the magnitude of equipment etc., and a basic component does not change but can apply this invention.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the outline sectional view of P-CVD system in which one example of this invention is shown.
[Drawing 2] the example of a configuration of an exhaust air baffle is shown -- it is an amplification perspective view a part.
[Drawing 3] It is the outline sectional view showing the example of application to the reactive ion etching system of this invention.
[Drawing 4] It is the outline sectional view showing the conventional P-CVD system.
[Description of Notations]
1 Vacuum Chamber
2 Shower Electrode
3 Lower Electrode
4 Exhaust Air Baffle
5 Evacuation Path
6 Flueing Opening